Each component should meet the following specifications as a minimum

**PART A: PHOTO VOLTAIC AND ELECTRICAL**

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| **SN** | **Item Description** |
| **1** | **PHOTO-VOLTAIC (PV) MODULES** |
| 1.1 | The capacity of the solar modules should be at least 50 % greater than AC motor pump. i.e at least 50% losses should be considered in the design, measured at STC |
| 1.2 | Module capacity should not be less than 390 W @STC |
| 1.3 | The solar modules should be designed to run near the MPPT |
| 1.4 | Type of cell: Mono Crystalline, 5 bus-bar technology |
| 1.5 | The PV manufacturer should be approved as tier 1. |
| 1.5 | Module efficiency: should not be less than 17% |
| 1.7 | No of cells in each panel: 72per panel; |
| 1.8 | Tolerance of maximum power rating: 0-5 W |
| 1.9 | The PV modules junction box must be IP67 |
| 1.10 | Should be supplied from approved tier 1 manufactures only. |
| 1.11 | Module Voltage: Not less than 1000 VDC; |
| 1.12 | Operating temperature: -40°C to 85°C |
| 1.13 | Temperature Characteristics: P max: -0.42% /C° or less |
| 1.14 | VOC: -0.31% /C° or less; |
| 1.15 | Nominal operating cell temperature (NOCT): 45 ±2°C.; |
| 1.16 | Weatherproof DC rated MC4 connector. Fully Secured, not allowing for any loose connections. |
| 1.17 | High transmittance tempered glass: Minimum thickness of 4.0 mm; |
| 1.18 | Must conform to IEC 61215, 61730, 61701, and UL 1703.TUV, UL certificates or equivalent; |
| 1.19 | Certificates and Data sheet of PV module that contains the P-V & I-V Curves, all electrical and mechanical Data, Dimensions, Module area should provide by bidder; |
| 1.20 | Performance warranty: Nominal power output 90% for 10 years, 80% for 25 years; |
| 1.21 | Product warranty shall be at least 10 years. |

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| **2** | **SOLAR PUMPING INVERTER CONTROLLER** |
| 2.1 | The solar pumping drive is required, the drive should have a long lifetime, low maintenance cost, inbuild MPPT + VFD (Variable Frequency drive). The drive rating should be 1.25 X AC motor pump rating and it shall follow below features: |
|  | Power ¨Not less than 5.5KW; |
| 2.2 | Three phase output, voltage range 380V; |
| 2.3 | Efficiency: Not less than 95%; |
| 2.4 | Output frequency: 50h±3%; |
| 2.5 | Enclosure class should be not less than IP55. |
| 2.6 | Maximum input voltage (Voc): not less than 750 VDC; |
| 2.7 | The system should be designed to run near its MPPT range; |
| 2.8 | Operating temperature: up to 45 °C; |
| 2.9 | Such device should have built in data loggers |
| 2.10 | The device shall allow hybrid operation with external power source, where solar power should be configured as the primary power source; |
| 2.11 | Soft start, V/F stable speed control during solar radiation changes, adjustable auto/ manual start in early morning, auto wakeup after adjustable hibernation time in cloudy days, o inputs for pressure switch and water level sensor to protect the pump against dry running and tank full water or closed pipeline (high pressure) |
| 2.12 | Display: LCD Screen display with Cover + LED status indicator |
| 2.13 | Protection: Over-Voltage, pump Over-Current, pump Over-Load, Over-Temperature, pump Phase Loss, pump Short-Circuit, ground fault, solar low power, DC Input Anti-reverse, AC output unbalance (single phase |
| 2.14 | Display content: PV status (Current, Voltage, Power, Energy), AC input voltage, AC output voltage, Load, Running Status, RPM, and Frequency. |
| 2.15 | Product warranty should be at least 2 years. |

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| **3** | **DC/PV COMBINER BOX** |
| 3.1 | The PV combiner box shall be used to combine the multiple DC input to one output, and it shall comply with the following specifications as minimum. |
| 3.2 | Enclosure materials: Coated metal with lockable door. |
| 3.3 | Enclosure protection: IP65. |
| 3.4 | Number of input circuit: total number of strings in addition to 2 spare inputs. |
| 3.5 | DC fuse rating for each string: 1000V, not less than 20 A. |
| 3.6 | DC output circuit: In accordance with the maximum current X 1.25, 1000 VDC breaker; |
| 3.7 | Built in surge protection device; |
| 3.8 | Anti-backflow diodes. |
| 3.9 | Operational Environment Temperature: -30 °C ~+70 °C; |
| 3.10 | Product warranty shall be at least 2 years. |

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| **4** | **SYSTEM CABLES** |
|  | Cables should be sized in accordance with IEC 60364-5-52 standard, bidders should submit cable sizing, and voltage drop calculations taking into account that the maximum voltage drop should be no more than 3% for each side (AC and DC); |
| 4.1 | **single phase, AC Submersible Pump Cable**: Voltage rating: 450/750VAC, Type of Conductor: copper, flexible, finely multi stranded, Insulation: black poly chloroprene, HO7RN -F or equivalent material |
| 4.2 | **DC Cable (From array to Combiner Box**): Made of double insulation material and jacket, TUV certified, 1000VDC, Sheath colours: black, red, Type of Conductor: tinned copper, flexible, finely multi stranded |
| 4.3 | **DC Cable (From Combiner Box to inverter):** Made of double insulation material and jacket, TUV certified, 1000VDC, Sheath colours: black, red, type of Conductor: tinned copper, flexible, finely multi stranded |
| **5** | **CABLE LAYING** |
|  | All above ground cables shall be installed in perforated galvanized cable tray with cover. Cable tray shall be supported with concrete blocks in appropriate intervals or on the mountings structure.  Under-ground cables shall be installed in cable trench 60 cm depth with PVC Sch#40 pipes as per drawings.  50% spare for future expansion. |

**PART B: MECHANICAL**

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| **7** | **WELL HEAD PIPING EQUIPMENT** |
| Piping equipment shall include any required fittings and materials for proper installation or existing system modification such as elbows, tees, sockets, flanges, piece of pipes, etc with high quality and high rating, piping equipment shall be installed inside valve chamber. | |
| **7.1** | **Mechanical Water Flow Meter** |
| 7.1.1 | Inline, Flanged, Magnetic type, Dray dial, turbine flow meter with all needed accessories such as threaded flanges, gaskets and bolts. |
| 7.1.2 | Nominal Diameter (DN): Shall be selected according to output pumping line diameter. |
| 7.1.3 | Nominal Pressure (PN): Shall be selected according to output pressure on the beginning of the pumping line. |
| 7.1.4 | Body: Cast Iron |
| 7.1.5 | Standard: EN14154, ISO4064 |
| 7.1.6 | Transient Flow Quantity: Shall be less than 50% of Pump flow rate. |
| 7.1.7 | Accuracy: ±2% of Nominal flow |
| 7.1.8 | Maximum dial indication: 999999 |
| 7.1.9 | Measuring Units: cubic meter m3 |
| **7.2** | **Horizontal Pumping line Non-return Valve.** |
| 7.2.1 | Nominal Diameter (DN): Shall be selected according to pumping line diameter. |
| 7.2.1 | Nominal Pressure (PN): Shall be selected according to output pressure on the beginning of the pumping line. |
| 7.2.2 | Connection Type: Flanged. |
| 7.2.3 | Type: Swing |
| 7.2.4 | Standard: BS5153 or Equivalent |
| 7.2.5 | Body Material: Cast Iron (Gg25) |
| 7.2.6 | Spindle: Stainless steel |
| 7.2.7 | Complete with flanges, gaskets, bolts and nuts |
| **7.3** | **Gate Valve** |
| 7.3.1 | Nominal Diameter (DN): Shall be selected according to pumping line diameter. |
| 7.3.2 | Nominal Pressure (PN): Shall be selected according to output pressure on the beginning of the pumping line. |
| 7.3.3 | Connection Type: Flanged. |
| 7.3.4 | Standard: BS BS6163 or Equivalent. |
| 7.3.5 | Operator: Hand Wheel |
| 7.3.6 | Resilient Seated. |
| 7.3.7 | Body Material: Cast Iron (Gg25) |
| 7.3.8 | Stem: Stainless Steel |
| 7.3.9 | Complete with flanges, gaskets, bolts and nuts |
| **7.4** | **Pressure Switch** |
| 7.4.1 | Hi pressure Low pressure function |
| 7.4.2 | Regulating range: Shall be selected according to output pressure on the beginning of the pumping line |
| 7.4.3 | NO/NC electric connection |
| 7.4.4 | NPT thread connection to pipe |
| 7.4.5 | Manual trip function |
| 7.4.6 | IP44 to EN 60529 / IEC 60529 |
| 7.4.7 | Shall be equipped with isolation Stainless steel 1/2-inch Ball valve of the same pressure rating. |
| **7.5** | **Analogue Pressure Gauge.** |
| 7.5.1 | Reading range: Shall be specified according to the pressure on the installation point preferably 0 – 30 bar |
| 7.5.2 | Process connection: NPT connection 1/2" or 1/4". |
| 7.5.3 | Pressure gauge should be equipped with isolation Stainless steel 1/2-inch Ball valve of the same pressure rating. |
| 7.5.4 | Casing: Stainless steel, 2.5-inches |
| **7.6** | **Well Cap / Cover** |
| 7.6.1 | Material: made from A36 or equivalent CS plate |
| 7.5.7 | Minimum thickness: 18 mm for borehole wells caps |
| 7.5.8 | Painted by Anti-corrosion Paint |
| 7.5.9 | Diameter: Shall be more than well diameter |
| 7.5.10 | Fabricated with stiffeners and holes for pump and sensor cables |
| 7.5.11 | Stiffeners shall be holed for lifting purposes |

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| **8** | **Submersible Pump and Motor** |
| **8.1** | **Pump** |
|  | * Submersible pump Mixed flow multi -stage separate type, AC 1PH motor type, the motor pump Sets should be used for the solar PV, Starting compatible with AC VFD operation, bidders shall indicate manufacture, country of origin and model. It shall follow below features as minimum: * Pump Efficiency at Duty Point: Not less than 80%, For wells that has TDH more than 50 m and Flow rate not less than 10.4 m3/hr Efficiency at Duty Point: Not less than 80% * Clearance (well dia-pump max dia with cable) = not less than 40 mm; * Casing (Pump Bowl ), Impeller , Wear Rings, Pump delivery and Housing , Check valve (None Return Valve) , Inlet strainer should be comply with: (AISI 304 or equivalent) or higher specification materials. * Shaft and coupling, Shaft sleeve, Bearing bush, Guide bearing, Screw, stud, nut, washer.. etc should be comply with: (AISI 304 or equivalent) or higher specification materials. * Maximum allowable sand: 100 gr/m3. * Coupling: according to NEMA. |
| 8.2 | **Motor** |
|  | * The motors shall be Rewindable, insulation rating is compatible with AC VFD operation * Motor power: (1.2\*Pump power) * Rated Voltage:380 VAC * Insulation Material and Class, PE2+PA, F or H * Ambient water temp:45 C° * IP: not less than 68 * Motor Efficiency: Not less than 80% * Motor Speed:1500rpm – 2500rpm * **Cooling sleeve** suitable for well internal diameter * Shaft, Motor Sleeve, Motor Housing, Diaphragm cover, bolts, Nuts, Studs, screws Washers etc. should be comply with: (AISI 304 or equivalent) or higher specification materials. * Shaft Seal (Mechanical Seal) Tungsten carbide/ceramic- Diaphragm Nitrile Rubber Radial Bearing (Guide Bearing) Graphite or superior Axial Bearing (Thrust Bearing) Graphite/ S.S Pads superior, Rubber Parts NBR or equivalent |
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| **10** | **GROUND LEVEL MOUNTING STRUCTURES** |
| 10.1 | **Method of Measurement:**  The quantities shall be calculated horizontally.  The quantities shall be computed net using dimensions from the drawing, unless directed otherwise by supervising Engineer.  No other type, terms or regulation for computing the quantities will be used and accepted.  Quantities may be rounded up or down where appropriate.  Fractional quantities are not generally necessary. If considered, such quantities shall be rounded off to two places of decimals. |
| 10.2 | **Material Specification:**  The horizontal distance between two adjacent mounting structures shall not be less than 1m as indicated in the layouts.  The distance between PV panels shall be not less than 2 cm from all sides.  The minimum height of mounting structures shall not be less than 80 cm as indicated in the shop drawings.  The tilt angle must be South orientation with a fixed tilt angle 12 degrees. |
| 10.3 | **Foundation of ground level mounting structures:**  For columns with a section of IPE100, their foundations are (0.5x0.5x0.5) m isolated footings reinforced concrete type C25 with reinforcement bars as shown in the shop drawings with installation of 4 anchor bolts Φ12mm 400mm long inside each footing and all necessary related work as detailed in the shop drawings. This work includes all excavations work and all necessary related work according to the shop drawings and the instructions of the supervising Engineer.  For all mounting structures, the bases are at least 50 cm height, for a minimum of 40 cm under ground level while 20 cm above ground level as per in the shop drawings.  The reinforced concrete with proportion cement/ sand/ gravel 1: 1.5: 3 respectively.  The reinforcement bars shall be with minimum yield stress 280MPa. |
| 10.4 | **Foundation of rooftop level mounting structures:**  If is required, the mounting structure columns shall be dropped and installed on the centre lines of roof slab beams as per in the shop drawings and the instructions of supervising Engineer.  Just in case the external roof is covered with screed concrete or cement tiles, making an opening on the cover {Size L30cm, W 30cm} is required in all solar mounting columns positions to fix the base plates of the mounting structure columns in the roof RCC slab.  The openings on the roof cover must be cut by using a Disk Grinder Machine.  The drillings of anchor concrete Bolts shall be on the reinforced concrete slab with (10 cm) depth and (16mm) diameter.  For all rooftop level mounting structures, the mounting will be installed on the roof slab and fixed by anchor concrete bolts by using **MASTER FLOW 932 AN(EPOXY) or (Master Brace ADH 2200 Part A + Master Brace ADH 2200 Part B)** which are embedment materials to install the anchor concrete bolts on the roof as indicated in the shop drawings. |
| 10.5 | **Fabrication:**  Supplying, fabricating, delivering at site, hoisting and fixing in position, including all temporary staging and supporting, work at all levels and locations, necessary scaffolding work and making all steel elements complete as per in the shop drawings for mounting structures.  All steel elements and shall be fabricated in shop such that welding in field shall not be required. |
| 10.6 | **Connections:**  Welding of galvanized elements is not allowed.  Welds to steel for mounting shall be full depth fillet welds unless otherwise stated in the shop drawings.  The Bolts shall be approved make with nuts of various diameters and lengths, Class 8.8 Type for joining of various Structural components like Column, Rafters, Beams, Purlins etc., complete as shown in the drawing and as directed by the RI Consultant and Engineer-in-Charge.  The length of bolts shall be such that the threaded portion of each bolt projects through the nut by at least two threads and by not more than five threads.  All fasteners (nuts, bolts and washers) shall be of Stainless Steel or galvanized steel.  All fasteners shall be tightening with designed torque mechanically.  Connection of columns and rafters shall be of Flange Haunch as indicated in the shop drawings. |
| 10.7 | **Coating for structural steel works:**  The first coat shall be from approved zinc chromite primer which applied by using mechanical spaying as well as final two coats of synthetic enamel paint over mounting elements except the galvanized elements as directed.  Weld and steel elements surfaces shall be clean and flush before application of the protective coating.  Steel shall not be welded after coating unless permitted by the Engineer and if permitted, the welded areas shall be free of scale and slag and shall be treated with an alternative galvanizing or zinc coating system approved by the Engineer. |

**PART C: SAFETY AND SECURITY**

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| **11** | **SECURITY FENCE** |
| 11.1 | Metal fence with Barbed wires as per in the shop drawings and the technical specifications, the work includes the following: |
| 11.2 | Provide materials and construction of 2.50-meter-high chain Link fence made from galvanized /or anticorrosion iron post 50 & 65mm DN that shall be embedded in concrete footings (40x40x50) cm C20 and pressed at end. The panel width is 3meter. The chain link 50mmx50mm opening and 3.15mm dim the work includes installing of three lines of Barbed Wires above. |
| 11.3 | Double leaf gate 2m in width, poles DN 65mm 2.5-meter height with BRC link 75mmx75mm spaces with all requirements |
| **12** | **SOLAR OUTDOOR LIGHTING** |
| 12.1 | Minimum capacity 60 Wp lamp compact type (All in one) or separated module (battery shall be built-in with the lamp) |
| 12.2 | Lamp luminous efficacy: not less than 100 Im/w. |
| 12.3 | Working lifetime: not less than 30,000. |
| 12.4 | The colour temperature range: 3000K – 5000K. |
| 12.5 | The LED lamps outdoor deigned with IP 65 protection. |
| 12.6 | Operating Temperature range: up to 60°C. |
| 12.7 | Certification: All related certificates shall be provided such CE, RoHS. |
| 12.8 | PV module and Battery capacities shall cover all energy consumption by lamp for 12 Hr at least. |
| 12.9 | Provided with mounting support and all required accessories. |
| 12.10 | Fence supports can be facilitated for the installation of lighting. Lighting pole should be 3-inch diameter. |
| 12.11 | Shall be distributed to light all area of PV modules and well-head room. |
| 12.12 | Warranty: at least two years. |